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SEVERAL REMARKS ON WATER AND CLIMATE

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The last two dry years have directed the attention of our public to problems of water and climate in our country, which had formerly been considered only by a few specialists. Certain water experts and biologists have for years been warning against the disruption of the biological equilibrium in certain areas of our country, but mostly in vain. All technical work has aimed only at achieving the greatest possible yield from the soil or a momentary commercial profit, without regard for the future. We will attempt an area analysis of this problem according to a number of works by water experts, biologists and climatologists, some of which are of outstanding quality (see Vl. Úlehla, Napojte Prameny, Prague, 1947). We will indicate those regions which have been most diverted from their natural biological and water equilibrium because of the undisciplined human longing for profit. For this purpose we have used analyses of cadastral measurements of administrative okreses, that is, analyses of the four vegetation components: fields, meadows, pastures, and forests. These analyses are the work of Engineer Jaroslav Okrouhlý, and were conducted according to the method of control limits.*) The principle of this method

*) Detailed information on area analysis using control limits will be found in the works of Engineer Okrouhlý, "Statistické Methody Užité v Regionálním Plánování", Statistický Obzor, Volume 27, No 2, or in the review Československý Průmysl, Volume III, No 5.

lies in the division of signs and thus of area as well into three parts according to two statistical measurements, the arithmetical average X and the dispersion σ: maximum values, which are greater than the average and the dispersion $(X + \sigma)$; average values, which fluctuate within the control limits $(X \pm \sigma)$; and values less than $X - \sigma$, which we call the minimum.

Before we deal with the detailed analysis of the appended maps, it is necessary to give the reasons why we have used analyses of cadastral measurements of fields, meadows, and forests in this work. In the first place, it must be emphasized that the bases of the water economy of a region, that is, the moisture content of the soil and the abundance of springs, are in direct correlation with the climatic conditions in the region.

Regulation of abundance of rainfall is almost impossible; therefore there is only one other possibility: the maintenance in a region of water supplies accumulated in a period of abundance for use in a period of shortage. This is really the whole principle of water economy, a subordinate element of which is the suitable distribution of water as a biological agent. One must determine where it is possible to maintain water supplies for a period of drought, and what types of vegetation are able to fulfill this important function in nature. If we look at a map of the flow of our rivers, we will find that all sources are in the border mountains or in the Bohemian-Moravian highlands and the Brdy. The entire area of our country may be divided into headwater regions and drainage regions. If we investigate the vegetation of headwater regions, we will find that these regions are or were covered primarily with forests and meadows. The drainage regions are now mostly under cultivation; only an insignificant portion has remained in meadow or forested. Some of them, such as the Polabí (region along the Elbe), the largest drainage region in Bohemia, were not continuously forested even in the past; in the opinion of Dr Böhm in Kronika Obieveného Věku, it was probably a bushy steppe. Here the function of maintaining soil moisture, which is performed in headwater regions primarily by forests, was taken over by grasses. Forests and meadows of headwater regions not only absorb great quantities of water in periods of abundant rainfall but they preserve them for periods of drought. Forests affect not only their own area but also a wider region, for which they form a natural barrier against dry winds. Thus the function of the forests of headwater regions is varied, and their influence on the vegetation of drainage regions is very great.

It has been said in the past that nature itself stores water for periods of drought, and distributes it wisely. The fact must be taken into consideration, however, that man has interfered with this natural cycle. Intensive interference with the natural water economy is to be observed in the Czech Provinces in the 19th and 20th centuries. It may be said that this influence for the most part has been harmful. This period was one of great development of liberalistic economy, both in the industrial and agricultural sectors. Both sectors have made basic investments to increase and cheapen production. There are improvement projects in agriculture whereby damp areas are drained and converted into fields for the cultivation of beets and grain. The rising demand for wood in the paper and chemical industries increases the price of wood; this results in intensive exploitation of forests and planting of cut areas with spruce monocultures, which grow rapidly and make continuous extraction possible. The greater consumption of meat and meat products encourages the raising of livestock, which need food; therefore fishponds and marshy meadows are drained in order to grow more hay. Improvement has become the motto of successful farming. Growing industry, which needs water for its operations, has occupied the banks of streams and dumped stinking and frequently poisonous wastes into good water. Industry also uses watercourses as sources of power and as cheap transportation routes. It was necessary to canalize rivers for purposes of communication and to regulate them for the rapid diversion of flood waters. River beds had to be deepened and banks reinforced so that they would not cave in. These investments, undertaken mostly from public capital, were on an immense scale, and radically changed the character of entire regulated river basins. River beds were frequently straightened, so that the current was accelerated. With the deepening of the bed, the level of a river dropped, and meadows bordering the bank were dried out. Bushes and trees, which strengthened the banks of streams, were removed and replaced by masonry dikes on which nothing would grow. If we examine the canalized lower course of the Vltava, Elbe, and certain other rivers, we will see veritable monuments to the negative interference of man in nature. It is understandable that such far-reaching adjustments affect the entire water economy, not only in the immediate area but in mountain streams and unregulated tributaries as well.

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Although problems of water supply are striking at first glance even for the lay observer, the effects of improvement projects are generally concealed from him; nevertheless they are frequently just as serious an interference in the water economy of nature and are even more dangerous, because they directly affect sources. Unsuitable interference frequently disrupts the water economy of a wide area, and the negative results are usually manifested several years later.

We have no statistical evidence as to how much land has been improperly subjected to improvement projects and what substantial damages have been caused by improper methods of regulating rivers; therefore we have used an area analysis of relative values for the measurements of three basic types of vegetation: fields, meadows, and forests. Unfavorable conditions in individual regions are partly the cause and partly the result of improper improvement and regulation measures. The restoration of equilibrium between areas of fields, meadows, and forests is one way toward rectification.

First we will give an analysis of cadastral measurements of fields (see Figure 1). The maximum values, greater than 62.83 percent of the total area of the okreses, take in the broad area of the central Polabí and the lower course of the Ohře in Bohemia, and the region of Haná and the okreses of southern Moravia. Fryštát Okres has an isolated maximum. Therefore all okreses with maximum values of cadastral measurements of fields lie in the drainage region. This phenomenon is understandable because the soil there is most fertile. Only the quantity of land devoted to fields is unusual. There is an excessive area of fields at the expense of meadows and forests. If there is a maximum area of fields in the drainage region, we would expect minimum areas in headwater regions. This supposition is only partially fulfilled. Minimum values are found in southern Bohemia and a part of the Šumava, the western part of the Ore Mountains, both northern spurs, a small part of the Giant Mountains, and the Beskids in Moravia. Other headwater regions have average measurements of fields, although we would expect minimum measurements; these are the central part of the Šumava, a part of the Ore Mountains, most of the Giant Mountains, the entire Orlické Hory, the Jeseníky, the White Carpathians, and

the Bohemian-Moravian highlands. These regions have a relatively large area of fields.

Cadastral measurements of meadows are given in Figure 2. Maximum values may be expected in headwater regions, because meadows and forests are natural water reservoirs. According to the map, this expectation is fulfilled only in part of the Bohemian-Moravian highlands, part of the Šumava, western Bohemia, and to a slight extent in northern Bohemia. Our expectation is not fulfilled in the Giant Mountains, Orlické Hory, Jeseníky, the Beskids, and part of the Bohemian-Moravian highlands. Meadows in these regions were probably drained and converted into fields. Moravia has been very heavily affected in this manner; its only maximum is in Moravský Beroun Okres. Minimum values of meadow area form a continuous region in central and northwestern Bohemia, and another continuous region in the okreses of southern and central Moravia. The okreses of Fryštát and Frývaldov are isolated minimums. With few exceptions, these okreses are in drainage areas; if we compare them with the okreses which have maximum values of field area, we will find that they are for the most part identical. This permits one to suppose that even in these regions meadows were converted into fields. The minimum value, which is less than 3.9 percent of the entire cadastral measurement of the okreses, is worthy of attention.

Figure 3, showing the cadastral measurements of forests, complements the two preceding figures; forest is a very important factor for water economy, not only as a natural reservoir of moisture but as a protection against desiccating winds. It should be expected that the maximum values of cadastral measurements would be found in headwater regions, that is, in the border mountains and the Bohemian-Moravian highlands. This expectation is fulfilled, however, only by the okreses of Sušice and Prachatice in the Šumava, Brdy, certain okreses in western Bohemia and the Ore Mountains, the okreses of northern Bohemia, and Vrchlabí Okres in the Giant Mountains. The Jeseníky and the Beskids in Moravia have maximum areas of forests. Our expectation is not fulfilled in most of the Giant Mountains, the Orlické Hory, and the Bohemian-Moravian highlands.

Minimum values of forest area are found in central Bohemia, the okreses of Mikulov and Hustopeče in southern Moravia, Přerov Okres in Haná, and the okreses of Nový Jičín and Frýštát. All these okreses are in the drainage regions; if we compare the three maps, we will find that, with few exceptions, these okreses have maximum areas of fields and minimum areas of meadows. It is evident that drainage regions have very many fields, few forests, and very few meadows. Not even headwater regions, however, are completely exempted from this imbalance; especially in the Giant Mountains, Orlické Hory, and the Bohemian-Moravian highlands fields are generally predominant. It must be added that a majority of the forests in headwater regions are spruce monocultures, which are threatened by bark-beetles. Therefore the forests are not able to fulfill their retention function as they should.

Conclusion

We have tried to point out certain disproportions in the cadastral areas of the three most important types of vegetation and to demonstrate that these disproportions have a causal relationship to the bad water situation of our country. We have indicated the causes of the slow desiccation of entire regions. We must now consider remedial measures, both in headwater and drainage regions. In the first place it will be necessary to return to a better relationship between areas of various types of vegetation, mainly to the advantage of meadows and forests. It is necessary to reconvert less suitable field areas into meadows and forests. Such action is especially urgent in the Polabí and southern Moravia. Furthermore it will be necessary to protect extensive field areas against dry winds by establishing forest belts and hedges, which would have the function of windbreaks, in addition to a number of other valuable advantages. Finally it is necessary to restore or build fishponds to raise the level of ground waters, especially in drainage regions. There are okreses which have no such area devoted to fishponds. In Bohemia, okreses are: Český Brod, Hradec Králové, Hořice, Kolín, Louny, Mělník, and Roudnice; in Moravia:

Holešov, Krnov, Moravská Třebová, Šternberk, Uherské Hradiště, and Uherský Brod. These okreses are found both in headwater and in drainage regions.

The most important prerequisite for improving the water situation is a greater understanding of nature, and the planning of future water projects not only from the technological and economic standpoint but from the biological standpoint as well.

Map Captions

Figure 1, page 177 - Cadastral areas in percentages of fields

Figure 2, page 178 - Cadastral areas in percentages of meadows

Figure 3, page 178 - Cadastral areas in percentages of forests